

**ABSTRACT**

The accumulation of the osmolyte glycine-betaine provides increased freezing tolerance (FT) in wheat. An exogenous application of betaine at room temperature increased FT by more than 5 degrees Celsius. The treated plants showed some of the characteristics of cold-acclimated plants and expressed the low temperature responsive gene *Wcor410* encoding a major membrane associated protein. The combined exposure to low temperature and betaine resulted in a cumulative effect on the improvement of FT which surpassed the genetic potential of the plant to withstand freezing. This result was demonstrated in wheat and barley under controlled environments and under field conditions for two grass species of golf turf. This important finding shows that an exogenous application of betaine before a predicted frost is usefully exploited to substantially improve cold or freezing tolerance in gramineae species, grasses, and other plants. This physiological treatment improves the genotype capacity to cold acclimate and acquire superior freezing tolerance without modifying the genetic background. These results show that manipulating endogenous betaine levels by any means should result in a similar improvement.